

## Towards a Sustainable Algiers: Analyzing Urban Typologies for Sustainable Cities

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### ABSTRACT

The rapid urbanization in Algeria has led to a focus on the forms and specifications of urban areas, particularly in Algiers, which necessitates innovative approaches for sustainable development. This study concentrates on Algiers, a city with a unique combination of architectural styles, encompassing various urban layouts, such as traditional Casbah, 19th-century colonial architecture, and modern structures. This study examines the sustainability and livability of each architectural typology through the application of a mixed-method approach that merges qualitative field observations with quantitative data sourced from academic publications. The findings revealed that each typology offers distinct sustainability advantages. These results emphasize the necessity of implementing a balanced urban development strategy that acknowledges historical contexts, while incorporating modern advancements to promote a sustainable future. This study provides essential insights into the relationship between urban typologies and sustainability in Algiers as well as the social impacts of each typology on citizen well-being and social cohesion.

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### 1. Introduction

Urban morphology studies city structures, focusing on their evolution through physical elements and various influences, promoting sustainable development via efficient land use, green infrastructure, and sustainable building practices (Ebaid & Helim, 2024). Sustainability, a holistic approach, integrates environmental, economic, and social dimensions, crucial for sustainable urban living. Global research on urban sustainability

includes urban form, social sustainability (Ali, 2022), and community sustainability (Arundel and Ronald, 2017). In Algiers, literature explores historical transformations, colonial impacts, and social uses of urban spaces, with Shen (2014), Souici (2015), and Hadjri and Osmani (2004) contributing to morphological change studies. However, comprehensive research on diverse urban forms and architectural styles defining sustainable cities remains insufficient.

This study analyzes Algiers' urban typologies, including the Casbah, French colonial areas, and modern monuments, through a sustainability lens (Kalan, 2022). It explores the city's spatial configuration, architectural features, sociocultural interactions, and historical evolution to provide insights into its urban fabric. Using mixed methods, the research identifies sustainable elements within each typology and examines the interplay between urban form, functionality, and sustainability, highlighting effective typologies for sustainable urban environments. The study emphasizes sustainability's impact on daily life, informs decision-making, and identifies exemplary layouts for future designs, contributing to resilient and harmonious cities. It lays the foundation for understanding urban form sustainability and guiding future sustainable urban development.

## 2. Literature Review

Urban morphology studies the form and structure of cities, focusing on the processes shaping them. It examines physical elements like buildings, streets, and green spaces, alongside social, economic, and environmental factors influencing urban development. Sustainable urban morphology aims to reduce environmental impact through efficient land use, green infrastructure, and eco-friendly building practices, aiding climate change mitigation and resource conservation (Ebaid & Helim, 2024). Well-designed urban forms enhance livability by improving accessibility, minimizing travel distances, and fostering community. They also drive economic growth by creating dynamic and attractive spaces for businesses and tourists (Mouratidis, 2019).

Sustainability aims to meet present needs without jeopardizing future generations. Urban forms profoundly influence daily life and sustainability. This study assesses various urban typologies based on social, economic, and environmental factors and their impact on community livability. Sustainability balances environmental, social, and economic interests to ensure long-term well-being by using resources responsibly and protecting the environment (Liang et al., 2021). It integrates these aspects to align human activities with the natural environment (Hajian & Kashani, 2021). Defined by the Brundtland Commission (1987), sustainability meets current needs without impairing future generations, emphasizing the interconnectedness of ecological, economic, and social justice (Redclift & Springett, 2015). It is crucial for resource availability, environmental protection, social equity, innovation, growth in sustainable sectors, waste reduction, enhanced organizational reputation, addressing global issues like poverty and hunger, and supporting the UN Sustainable Development Goals (Diaz & Saporiti, 2023). Sustainability tackles climate change and resource depletion, promoting global collaboration for common goals and planetary stewardship (Askar et al., 2021). Influential endorsements like the The Brundtland Report and Rio Summit have prompted varied interpretations from governments and corporations. Experts stress ecologically sustainable production within environmental boundaries while ensuring social well-being (Al Nasri and Khaled, 2023). Urban environments, defined by density, connectivity, and compactness, shape urban forms, impacting city

functionality, growth, and environmental effects like green space access and air pollution (Susan & Erdogan, 2022). Compact urban areas typically enhance public transport and decrease traffic emissions. Evaluating reforms using various metrics is crucial for urban planners and policymakers to make informed decisions. Effective urban design integrates density, land use, green spaces, and accessibility to achieve sustainability, enhancing resilience, improving quality of life, and reducing environmental impacts. Algiers, Algeria's capital, illustrates the intricacies of urban development (Austin, 2019). Influenced by colonial invasions, particularly French rule, Algiers has progressed through multiple stages, including the casbah, the colonial city, and modern architecture (Lafi, 2016). The Casbah, a UNESCO World Heritage Site and Algiers' Central Historic District, embodies traditional architecture with winding streets, courtyard homes, and intricate details, merging Berber, Ottoman, and Moorish influences (Austin, 2019). The colonial period introduced French-inspired architecture, while modern developments reflect contemporary styles and urban layouts shaped by evolving socioeconomic dynamics and planning paradigms.

This study examines Algiers' urban layouts from a sustainability perspective, addressing environmental, social, and economic aspects to contribute to developing more sustainable and cohesive cities. Understanding the sustainability implications of Algiers' diverse urban typologies is vital for informed urban planning and decision-making. By identifying the strengths and weaknesses of each typology, this study aims to guide strategies for enhancing urban sustainability, promoting inclusive development, and preserving Algiers' cultural heritage.

## 3. Methodology

This research employs qualitative and quantitative methods to assess the sustainability of urban architectural styles in Algiers, focusing on the traditional Casbah, 19th-century colonial buildings, and contemporary architecture, chosen for their historical significance and impact on the urban landscape. Case studies were selected based on historical importance, architectural uniqueness, and urban impact. The Casbah represents traditional urban patterns, while colonial and modern structures illustrate design changes during and after French colonial rule, facilitating comparative analysis. Data was sourced from academic literature, official records, and on-site observations, with a literature review conducted using specific search terms in digital databases.

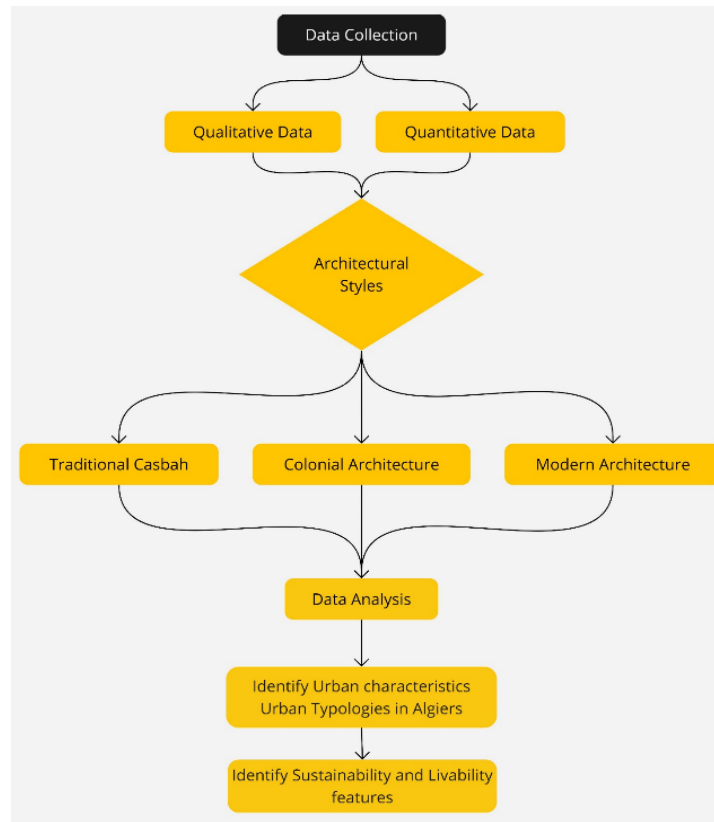
To gain comprehensive insights from residents, in-depth interviews were conducted, focusing on the perceived sustainability of each architectural style, their impact on daily life, and challenges or opportunities for their conservation and modification. These interviews provided qualitative data that complemented the quantitative findings.

Typomorphological and solid-void evaluations analyzed urban forms, spatial organization, and the relationship between built and unbuilt spaces within each typology (Figure 1). Comparisons identified sustainability characteristics, supplemented by a literature review on sustainability aspects, with the data analysis

process documented for transparency and replicability. Sustainability features were listed and compared across typologies, incorporating comparative insights to highlight sustainability integration.

"Towards a Sustainable Algiers: Analyzing Urban Typologies for Sustainable Cities" utilizes a mixed-method approach, selecting

academic sources based on relevance, author credibility, and publication impact to ensure data reliability. The research maintains ethical standards through transparency, replicability, and integrity in data collection and analysis, acknowledging reviewers' contributions to uphold the study's quality and ethical standards.



**Figure 1.** Diagram representing the whole methodology (Authors)

## 4. Analysis and Comparison

### 4.1 Introduction to Algiers

Algiers, Algeria's capital, exemplifies diverse Mediterranean heritage and culture. Located on the North African Mediterranean coast (Figure 2), the city has been shaped by various civilizations and political movements (Figure 3). Algiers' urban landscape is categorized into traditional, 19th century, and modern. The traditional typology, represented by the historic Casbah, a UNESCO World Heritage site, showcases Ottoman-era urban

planning and architecture. The 19th century category, developed during French colonial rule, features Haussmann-inspired avenues and European-style structures. The modern category, post-independence, highlights contemporary urban design and architecture (Figure 4). This overview underscores Algiers' significance and its urban typologies, examined from urban and sustainability perspectives.

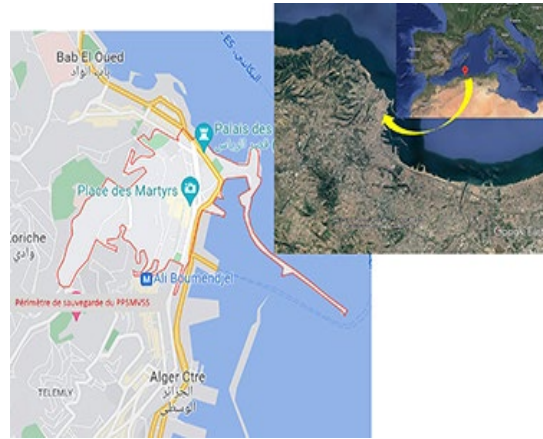


Figure 2. The city of Algiers (Djedi, 2022)

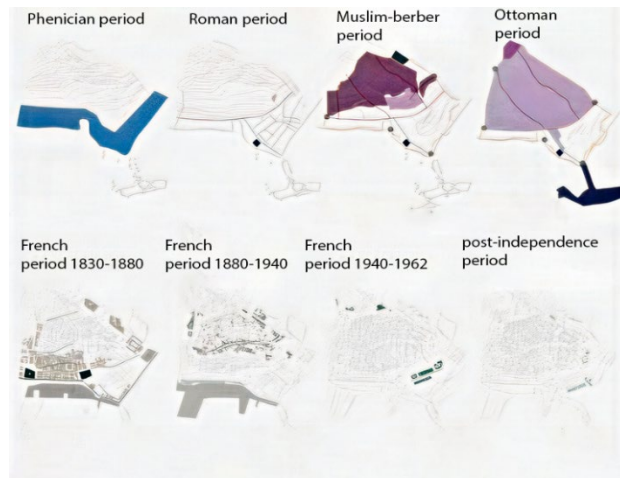


Figure 3. Evolution of Algiers (Authors)

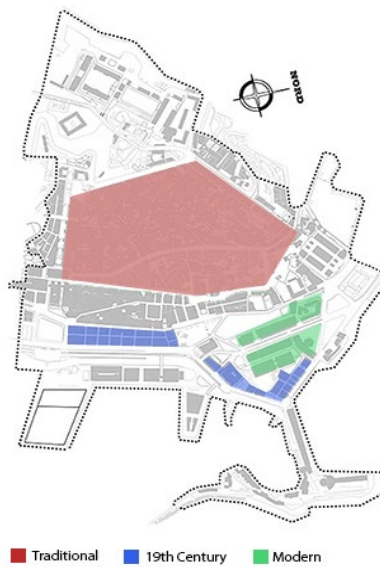
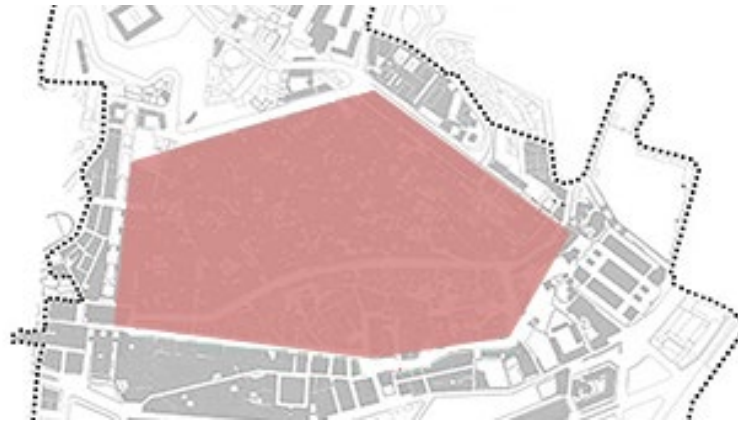


Figure 4. The three typologies (Authors)

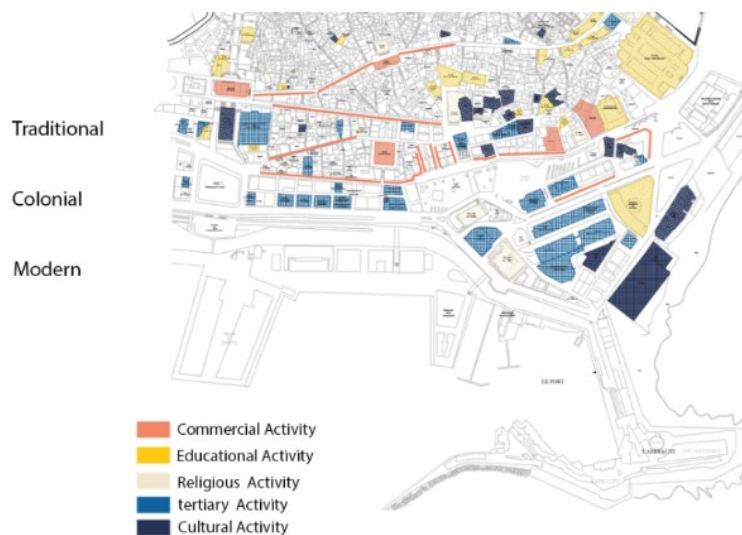
#### 4.2 Traditional Typology: Casbah

The Casbah of Algiers, a UNESCO World Heritage Site, represents traditional Algerian architecture (Figure 5). Its dense, organic urban form, adapted to the natural terrain, features narrow, winding streets, inward-facing courtyard homes, and a

hierarchical spatial layout that separates public and private spaces. These characteristics promote walkability, reduce automobile dependence, and enhance social cohesion, exemplifying sustainable urban design (Figure 6) (Missoum, 2003; Khemri, 2020).



**Figure 5.** The traditional casbah (Authors)



**Figure 6.** Example of the activities (Authors)

The Casbah historically transitioned from a strategic fortress to a densely populated residential area, mirroring the city's social and cultural dynamics. Its architecture, built from local materials like stone and clay, offers natural insulation and ventilation, thus

lowering energy use (Khemri, 2020). The urban design, emphasizing community interaction and privacy, fosters vibrant public life and maintains social order (Figure 7) (Missoum, 2003; Shual, 2002).



**Figure 7.** Built and empty system (Authors)

Algiers, originally called the Casbah, has experienced notable transformations since its inception. The city's structure distinctly separates public and private spaces, shaped by the natural landscape and historical evolution. After the French conquest in the 1830s, the urban fabric of Algiers, which previously extended to the harbor, underwent extensive changes, including demolitions and the creation of boulevards and a large plaza, as part of military engineering efforts (Shuval, 2002).

#### 4.2.1 Urban Analysis

The city's lower administrative and military center contrasts with the upper residential area. The Casbah separates commercial zones in lower areas from residential hillside neighborhoods, creating an intricate street network adapted to the terrain (Missoum, 2003). Dead-end "impasses" reflect a hierarchy from main roads to private spaces, mirroring the transition from communal to family domains, with higher concentrations in the upper district indicating a preference for privacy, fundamental to traditional Arab urban design (Missoum, 2003; Shuval, 2002). The Casbah's narrow, irregular streets and inward-facing homes with central courtyards for light and ventilation reflect an introverted lifestyle prioritizing privacy (Figure 8).



**Figure 8.** Different pathways of the casbah (Authors)

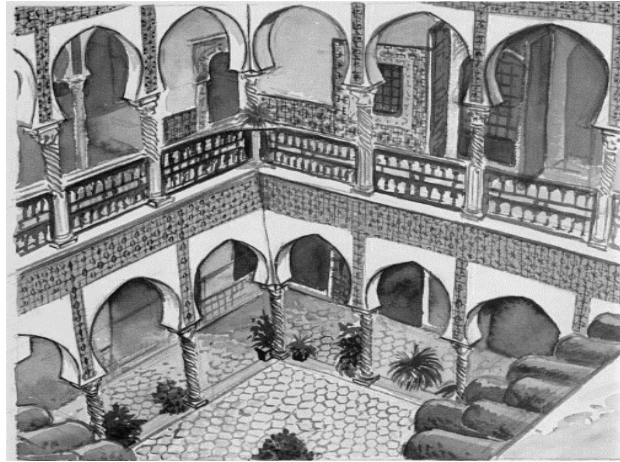
Simple facades with limited windows above eye level maintain privacy, while shared walls, vacant lots, and wall fountains in dense urban settings serve as informal gathering spots, promoting pedestrian activity, community belonging, and safety. The

compact design and hanging vines provide resilience against harsh climates (Khemri, 2020). The Casbah's traditional typology encompasses diverse architectural forms, including courtyard houses, mosques, and cultural institutions, with a complex,

irregular street pattern reflecting organic historical development. Open spaces appear as small gardens, plazas, and friches, primarily within building courtyards (Missoum, 2003; Khemri, 2020). In the Casbah, solid features like courtyard dwellings, narrow winding streets, and intricate decorations dominate, while void spaces comprise smaller green areas and courtyards within buildings (Missoum, 2003; Khemri, 2020).

#### 4.2.2 Sustainability Analysis

The traditional architecture of the Casbah in Algiers is notable for its integration with streets. Casbah homes typically feature main entrances and living areas facing the street, fostering neighborhood connections. These homes often include small courtyards or gardens that, while private, remain visible on the street. This design created a vibrant atmosphere (Figure 9) (Khemri, 2020).

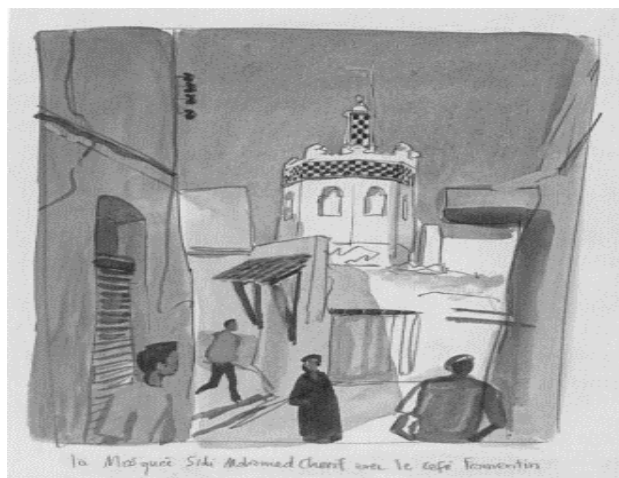


**Figure 9.** The patio of the casbah (Touzout, 2015)

Casbah's pre-colonial architecture, with its winding streets, tall white buildings, and intricate designs, uses local materials like clay and stone. Recognized as a UNESCO World Heritage Site, it holds significant historical and cultural value. From sustainability and livability perspectives, Casbah's urban design features landmark elements and winding streets that promote walkability while maintaining a hierarchical structure of avenues, alleys, and boulevards (Brahimi & Benhamouche, 2023). This architectural approach reduces dependence on cars, enhances air quality, and promotes active lifestyles. The compact nature of Casbah also facilitates energy-efficient transportation and reduces

the demand for extensive climate control systems (Figure 10) (Brahimi and Benhamouche, 2023). When local Casbah residents were interviewed, one responded to a question about how sustainability features contribute to livability:

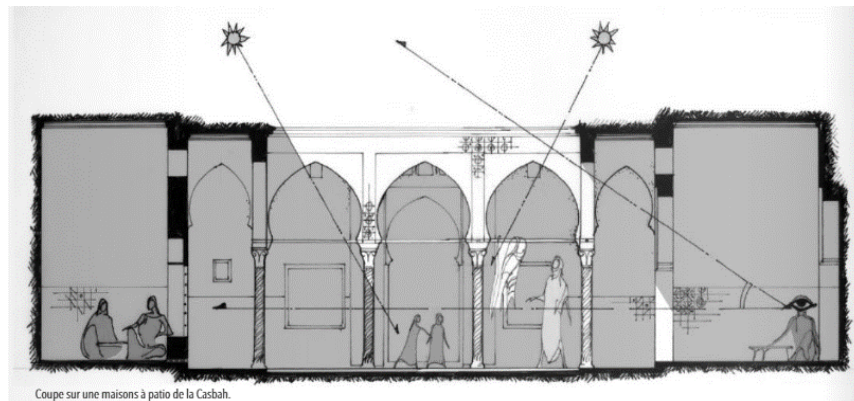
"I believe it's a crucial aspect. The proximity of everything means we have less need for automobiles. This results in decreased pollution and less noise from traffic. Additionally, the compact design allows for energy conservation, particularly in terms of heating and cooling."



**Figure 10.** Walkability in the casbah (Touzout, 2015)

Casbah homes' thick stone or clay walls offer natural insulation and cooling during hot summers. Small openings, called *mushrabiya*, enhance ventilation and heat dissipation (Karabag and Fellahi, 2017). Additionally, terrace architecture and

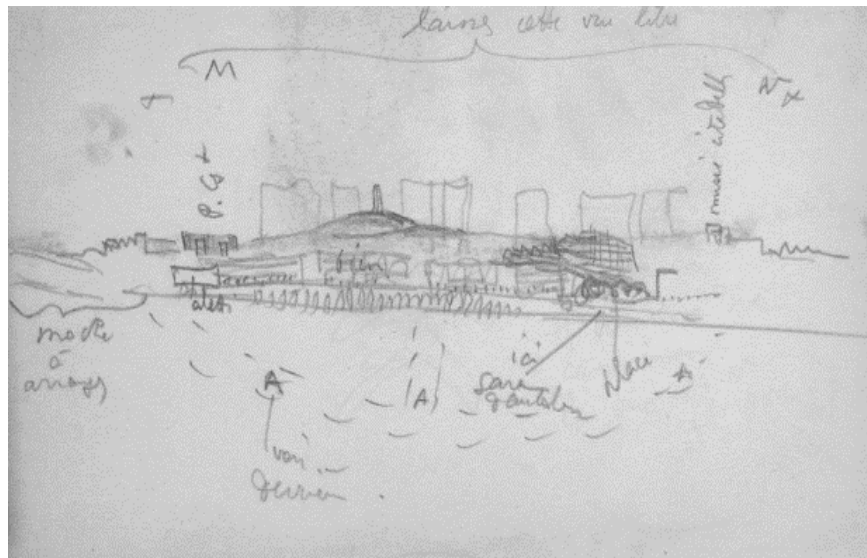
rammed earth walls and patios create comfortable living spaces, minimize overheating, reduce air conditioning use, and lower energy costs (Figure 11) (Karabag and Fellahi, 2017).



**Figure 11.** The sources of natural light and ventilation (Source: Touzout, 2015)

Casbah's architecture creates a visually engaging and comfortable urban environment that enhances residents' well-being (Karabag and Fellahi, 2017). The colorful materials, winding streets, terraced structures, and open spaces form an inviting landscape that boosts aesthetic appeal and psychological health. Traditional Casbah homes, built with locally sourced renewable materials, reduce energy consumption and support sustainability (Karabag and Fellahi, 2017). The hill positioning enables efficient water management systems that collect and handle rainwater, enhancing resilience during shortages (Karabag and Fellahi,

2017). Public spaces slow water flow for reuse, and rammed earth walls reduce runoff. The architecture also fosters social sustainability by encouraging community interactions (Khemri, 2020). Narrow, winding streets slow traffic and promote gatherings, strengthening social cohesion. Casbah serves as a model for sustainable and livable design, influencing modern architects like Le Corbusier (Figure 12), demonstrating how social diversity can be achieved through thoughtful urban planning (Figure 13).



**Figure 12.** Sketch from Le Corbusier of Algiers and Casbah in 1933 (Touzout, 2015)





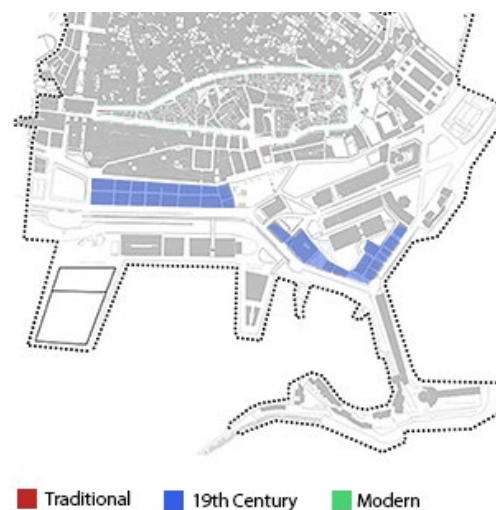
**Figure 13.** Sustainability and Livability Features (Touzout, 2015)

Having explored the Casbah's intricate urban design and its contribution to sustainable living, we now turn our attention to the colonial and modern architectural influences that represent Algiers' evolution in response to historical changes and contemporary challenges.

#### 4.3 *The 19th Century Typology*

North African cities, such as Algiers, experienced significant urban development due to colonial influences (Khemri, 2020).

French colonization in Algeria led to major urban planning changes, mirroring Haussmannian renovations in Paris. These included demolishing districts and introducing a new design with wide boulevards, and public spaces (Khemri, 2020). During France's 132-year occupation, Algiers' urban growth was profoundly impacted. The Casbah, the historic center, was reduced and transformed from a medieval medina into a modern urban area. The original winding streets were replaced with a grid-like pattern of large squares to facilitate military operations (Figure 14) (Icheboudene, 2002; Hadjri and Osmani, 2004).



**Figure 14.** 19th century colonial fabric bottom of the casbah (Authors)

#### 4.3.1 Urban Analysis

Colonial architecture reshaped the urban landscape, replacing traditional buildings with military installations, public areas, and residential zones. Government structures adopted Neoclassical and Neo-Moorish styles, while Haussmannian design influenced apartments, reflecting France's aim to establish a model French urban center in Africa (Icheboudene, 2002).

The 19th-century colonial buildings in Algiers exhibit a blend of European styles, mainly Neoclassical and Neo-Moorish,

symmetrical facades, central entrances, and evenly spaced elements embody classical ideals of balance and harmony. Columns and curved entryways, often decorated with moldings, sculptures, and stained glass, add to their grandeur. Colonial architects used local materials like stone and clay, respecting regional resources and traditions.

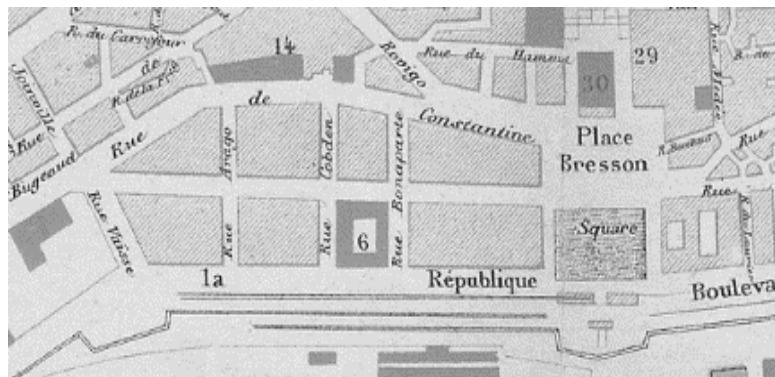
These buildings were part of an urban layout with wide streets, boulevards, and public squares designed to improve traffic flow, support military operations, and modernize the city. The colonial administration's focus on order, efficiency, and control is evident in the meticulous planning of these spaces (Figure 15).



**Figure 15.** The Colonial Architecture (Deluz, 1988)

In Algiers, colonial urban planning prioritized symmetrical, orderly street layouts with tree-lined roads, wide boulevards, and public spaces (Figure 8) (Kobis, 2017). Residential buildings were more modern and taller than those in the traditional Casbah, featuring uniform exteriors, covered walkways, and street-facing balconies (Bouaouina, 2006). This design approach aimed to

balance built environments with open areas, including expansive avenues, governmental buildings, and residential zones (Figure 6). While parks and green spaces were part of this plan, they were less extensive and more condensed compared to typical city designs (Figure 16).



**Figure 16.** Plan of colonial typology (Deluz, 1988)

The 19th-century colonial architecture in Algiers merges European Neoclassical and Neo-Moorish styles, adapted to the local climate and culture. These buildings feature balanced facades, columns, arches, intricate decorations, and locally

sourced materials. Urban planners designed wide avenues, main streets, and public squares to create a modern, orderly environment. This architecture reshaped Algiers' sociocultural landscape by displacing communities, enforcing population shifts,

and introducing Western cultural elements. It also reflected social hierarchies, with grand structures for the colonial elite and modest ones for local residents. The blend of European and indigenous influences, incorporating local materials and design, aimed to create a sense of belonging while asserting colonial dominance and cultural appropriation.

Colonial architecture significantly impacted Algiers' social and cultural fabric by replacing the close-knit spaces of the Casbah with broader avenues and contemporary buildings, altering social dynamics and community bonds. The demolition of parts of the Casbah for colonial structures displaced residents, fracturing communities and cultural practices, leading to feelings of estrangement and deprivation. European architectural styles and urban planning introduced Western cultural changes, affecting fashion, language, and social customs, thereby transforming the city's landscape and societal norms. The incorporation of local elements in colonial architecture represented cultural appropriation, as these features were used to create a sense of place while attempting to control and assimilate local culture.

#### 4.3.2 Sustainability Analysis

Colonial buildings in Algiers, despite their architectural beauty and historical significance, face various sustainability issues. The 19th-century colonial architecture in Algiers includes sustainable design elements now prominent in discussions on eco-friendly construction. Key features include the use of locally available materials like stone and clay, providing natural insulation and reducing energy consumption. This material choice was environmentally efficient and suited the local climate and resources, exemplifying early sustainable practices (Darwish, 2016). Emphasis on natural ventilation and light management is another critical aspect. Buildings from this era often had narrow streets and tall structures to address harsh weather, particularly in arid regions. They incorporated small windows and high ceilings to enhance air circulation and minimize heat buildup, ensuring comfort without modern mechanical systems (Michal & Chalfoun, 2007). These strategies were vital for maintaining livable conditions without contemporary HVAC technology. The adaptive reuse of historic structures also offers significant sustainability benefits. Conserving and repurposing old buildings reduces the need for new construction materials, preserving resources and decreasing environmental impact. However, modifying these structures to meet modern requirements, such as improving energy efficiency or upgrading facilities, can be challenging but necessary for continued use (Abreu, 2018). A local resident emphasizes that the buildings' livability is compromised due to the architectural style, which was imported and unsuitable for Algiers' environment. Many structures suffer from poor insulation and outdated climate control systems.

Addressing sustainability concerns is essential for the long-term preservation of colonial buildings in Algiers. Measures like energy-efficient upgrades, improved ventilation, and adaptive reuse can maintain these historic structures and enhance their sustainability for future generations. Colonial architecture introduced a mix of European styles and urban planning, setting the stage for modernist efforts to meet Algiers' evolving urban needs and prompting discussions on modern typologies.

### 4.4 Modern Typology

#### 4.4.1 Urban Analysis

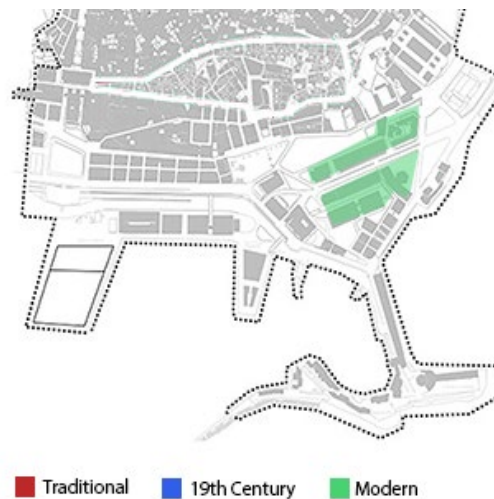
Algiers' French colonial architecture, characterized by modernist, prefabricated designs, leads to rapid yet visually monotonous construction with little social cohesion (Çelik, 1997). Uniform structures with central yards miss the diverse functions vibrant communities need, and neglected communal areas contribute to urban detachment (Çelik, 1997). Influenced by modernist principles, especially those advocated by Le Corbusier, Algiers adopted rational planning and functional zoning, segregating living, working, and leisure spaces with broad avenues for traffic and distinct residential from commercial areas. This approach, while aiming for efficiency and sunlight optimization in high-rise blocks, often resulted in lifeless, functionally singular environments. Public spaces, large but disconnected from living areas, failed to integrate into the communal fabric, overlooking the city's social and cultural needs.

Current initiatives focus on harmonizing new constructions with Algiers' landscape, enhancing transit access, communal zones, and local facilities. Modern plans feature broader streets and public areas bridging the gap from the Casbah's tight lanes to more vehicular and public-friendly layouts, yet sometimes remaining isolated from residential dynamics (Çelik, 1997). Latest efforts strive for multipurpose areas blending residential, commercial, and public uses, redesigning walkways and spaces for improved transport and social engagement. These projects introduce greenery, pedestrian zones, and amenities, aiming to marry functional design with the city's social and cultural essence.

#### 4.4.2 Sustainability Analysis

##### Criticisms and Improvements

A significant critique of modernist architecture in Algiers is its disregard for local culture. The standardized designs often appear out of place in a city rich in historical and cultural heritage. Consequently, architects and urban designers are exploring ways to integrate local elements into contemporary designs, such as using traditional materials, patterns, or architectural forms in modern contexts (Figure 17).



**Figure 17.** The modern typology (Authors)

Modernist projects in Algiers often create isolated neighborhoods that provide housing and amenities but feel disconnected from the wider urban fabric, necessitating multi-functional zones integrating residential, commercial, and public spaces for a vibrant, cohesive urban environment. Contemporary architecture emphasizes modern aesthetics, innovation, and efficiency, with varying eco-friendliness and livability, incorporating energy-saving features but failing to integrate with

the traditional urban layout, resulting in uniform, isolated areas neglecting local needs and cultural diversity, as voiced by inhabitants who return to the casbah for daily community interaction. Algiers' focus on high-rise buildings, wide roads, and modernist designs with minimal solid elements, despite including green spaces and facilities, lacks the community engagement and social cohesion of traditional neighborhoods, prompting calls for more integrated urban planning (Figure 18).



**Figure 18.** Modern architecture buildings (Cohen, et al., 2003)

Modern architecture in Algiers has enhanced energy efficiency and accessibility, but its impacts on community bonds, urban integration, and environmental sustainability must be considered. Balancing contemporary design with residents' and environmental needs will allow Algiers to develop its urban landscape beneficially for both its inhabitants and the planet.

#### Contemporary Examples

Algiers showcases contemporary architecture that integrates with the city's urban fabric while addressing modernist design

critiques. The Grand Mosque of Algiers exemplifies this blend, incorporating traditional Islamic elements with a modern aesthetic. Its expansive courtyard and public spaces contribute to a vibrant urban center. Similarly, the Bab Ezzouar Residential Complex includes green spaces, children's recreational areas, and commercial facilities, enhancing livability and integration with the environment. This development demonstrates how modernist principles can support sustainable and inclusive communities. By considering societal, cultural, and ecological impacts, contemporary architecture can create buildings that

meet practical needs and enhance the urban landscape and quality of life (Figure 19).



**Figure 19.** The modern project Bab Ezzouar Residential Complex (Nest Properties)

## 5. Results and Discussion

Algiers' rich architectural heritage is a testament to its complex history and diverse cultural influences. Three primary typologies—the traditional Casbah, 19th-century colonial architecture, and modernist developments have shaped the city's urban landscape. Each typology offers unique insights into Algiers' past and present, reflecting distinct historical periods, cultural values, and architectural approaches.

In the following sections, we will delve into the architectural features, urban integration, and sustainability aspects of each typology, providing a comprehensive overview of Algiers' multifaceted urban architecture.

### Traditional Casbah Architecture:

The Casbah of Algiers exemplifies traditional Algerian urbanism, featuring a compact, organic layout that aligns with the city's topography, creating a labyrinthine with narrow, winding streets and intricate alleyways. The buildings, made from local materials, have inward-facing courtyards to maximize natural light and ventilation, emphasizing privacy and community interaction. The dense, interconnected structure provides natural insulation and security, while incorporating small courtyards, narrow alleyways, and public squares to facilitate community engagement and pedestrian movement. This design fosters walkability, improved air quality, and physical activity, with traditional homes offering natural insulation and ventilation, reducing energy use. The Casbah of Algiers serves as a model of sustainable urban development, demonstrating the benefits of a compact layout, traditional building techniques, and strong community emphasis.

### 19th-Century Colonial Architecture:

The French colonial period in Algiers left an architectural legacy of grand boulevards, imposing public buildings, and a European urban planning style. Unlike the labyrinthine layout of the Casbah, colonial Algiers featured a structured, rectilinear design with wide avenues and regular street grids. Influenced by Neoclassical and Neo-Moorish styles, colonial architecture aimed to showcase French power and prestige through monumental

public buildings like government offices, theaters, and churches, often with ornate facades and expansive public spaces.

However, this emphasis on large, open spaces and wide streets fostered social cohesion and recreation but created issues for residential buildings, often lacking adequate ventilation and natural light. Dense urban development combined with European-style architectural features led to problems in hygiene, energy efficiency, and overall livability. Despite these limitations, colonial architecture in Algiers remains integral to the city's historical fabric. The grand boulevards, public squares, and imposing buildings offer a glimpse into the past and continue to shape the city's identity. As Algiers progresses, it must balance preserving its colonial heritage with addressing modern population needs.

### Modern Architecture:

Algiers' modern architecture emphasizes practicality, efficiency, and adaptability through high-rise buildings, standardized layouts, and grid-like streets. Sustainable elements like solar panels and green roofs are incorporated, reflecting environmental responsibility. The skyline showcases efficient construction techniques, with layouts including open spaces and public amenities. Materials like steel, glass, and concrete optimize space and functionality, contrasting traditional enclosed spaces with larger voids. Sustainability is central, with advanced techniques and renewable energy employed for environmental performance and comfort. However, balancing innovation with cultural sensitivity remains challenging, as modern developments can lack cultural integration and social connectivity. Modernist architecture emerged due to rapid growth demands, modernizing the city but facing criticism for not integrating cultural elements and creating impersonal spaces. Recent initiatives aim to enhance sustainability and livability through mixed-use areas, green spaces, and pedestrian zones.

Algiers has three architectural typologies: the traditional Casbah, 19th-century colonial buildings, and modern developments, each with unique urban design and spatial features. The Casbah's organic, maze-like layout contrasts with the grid-based patterns of colonial and modern architectures. The Casbah emphasizes solid structures, creating a private environment, unlike the colonial and modern designs that integrate solid and open elements to foster community interaction and leisure. These

varying urban planning strategies highlight the diverse approaches of each typology and enhance the understanding of Algiers' complex urban landscape. Table 1 summarizes the key aspects of each typology, focusing on typomorphological traits and the relationship between buildings and open spaces.

**Table 1.** Comparative Analysis of Architectural Typologies in Algiers: Typomorphological and Solid-Void Perspectives : The table offers a comparative examination of Algiers' three main architectural styles: the traditional Casbah, colonial structures from the 19th century, and contemporary constructions. This analysis is based on their typomorphological features and an evaluation of solid-void relationships.

Typology	Typo morphological Characteristics	Solid-Void Analysis
<b>Traditional Casbah</b>	Organic, intricate network of alleyways, compact layout, inward-facing courtyards	Predominance of solid elements (buildings), limited void spaces (courtyards, narrow alleyways), strong sense of enclosure
<b>19th-Century Colonial Architecture</b>	Grid pattern, wide boulevards, public squares	Emphasis on void spaces (public squares, parks), larger buildings, open layout
<b>Modern Architecture</b>	Standardized blocks, high-rise buildings, often isolated communities	Balance of solid and void elements, large buildings, expansive public spaces

This study investigates the sustainability and societal impacts of Algiers' Traditional Casbah, Colonial Architecture, and Modern Architecture. As shown in Table 2 The Casbah's dense layout, local materials, and natural ventilation promote community bonds, privacy, and walkability. Colonial Architecture faces sustainability challenges due to age and modernization needs, often displacing locals and appropriating culture. Modern Architecture supports sustainability through eco-friendly

construction and mixed-use projects but may lead to social isolation without community involvement. Comparative analysis suggests blending the Casbah's design with modern sustainable elements and addressing colonial building issues could create a balanced urban environment. Conserving the Casbah's historical essence while integrating modern amenities could enhance livability and contribute to a diverse, inclusive cityscape, guiding future urban development in Algiers.

**Table 2.** Comparative Analysis of Architectural Typologies in Algiers: Sustainability Perspective

Typology	Key Sustainability Features	Challenges
<b>Traditional Casbah</b>	Natural insulation, walkability, social cohesion	Preservation, modernization without compromising heritage
<b>Colonial Architecture</b>	Use of local materials, climate adaptation	Retrofitting for energy efficiency, cultural appropriation
<b>Modern Architecture</b>	Energy-efficient designs, mixed-use developments	Social integration, addressing isolation and monotony

## 6. Conclusion

This study explores the crucial issue of preserving urban architectural identity while accommodating contemporary needs in a swiftly changing metropolis like Algiers. Through an analysis of architectural development across three primary typologies—the traditional Casbah, colonial structures from the 19th century, and modernist constructions—this research illuminates the intricate relationship between historical conservation, cultural heritage, and sustainable urban growth. The results indicate that while the Casbah exemplifies sustainable design grounded in local customs and community-centric layouts, colonial-era buildings, despite their historical importance, require significant updates to align with current sustainability criteria. Modern architecture, initially criticized for its lack of connection to Algiers' cultural

context, is progressively adapting to incorporate more inclusive and sustainable urban strategies.

The principal conclusion of this study emphasizes the critical need to strike a balance between preserving historical elements and implementing modern sustainability practices. Urban planners, architects, and policymakers must acknowledge the distinct contributions of each architectural style to Algiers' urban landscape and develop a unified approach that respects the city's rich cultural legacy while addressing future environmental and social challenges. This research highlights the significance of a comprehensive approach to urban development that not only safeguards the past but also embraces innovations to ensure the long-term viability of the city's architectural identity.

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